



WetLab-2

Quantitative PCR tools for spaceflight studies of gene expression aboard the International Space Station

Wetlab-2 is a research platform for conducting real-time quantitative gene expression analysis aboard the International Space Station. The system enables spaceflight genomic studies involving a wide variety of biospecimen types in the unique microgravity environment of space.

Currently, gene expression analyses of space-flown biospecimens must be conducted post-flight—after living cultures or frozen or chemically fixed samples are returned to Earth from the space station. Post-flight analysis is limited for several reasons. First, changes in gene expression can be transient, changing over a timescale of minutes. The delay between sampling a culture in space and analyzing that sample on Earth can range from days to months, and RNA may degrade during this period of time, even in fixed or frozen samples. Second, living organisms that return to Earth may quickly re-adapt to terrestrial conditions. Third, forces exerted on samples during reentry and return to Earth may affect results. Lastly, follow up experiments designed in response to post-flight results must wait for a new flight opportunity to be tested.

Wetlab-2 solves these problems by allowing investigators to obtain real-time genomic data



The Wetlab-2 system includes a Cepheid SmartCycler instrument that can perform up to 16 PCR reactions in parallel. Image credit: NASA / Dominic Hart

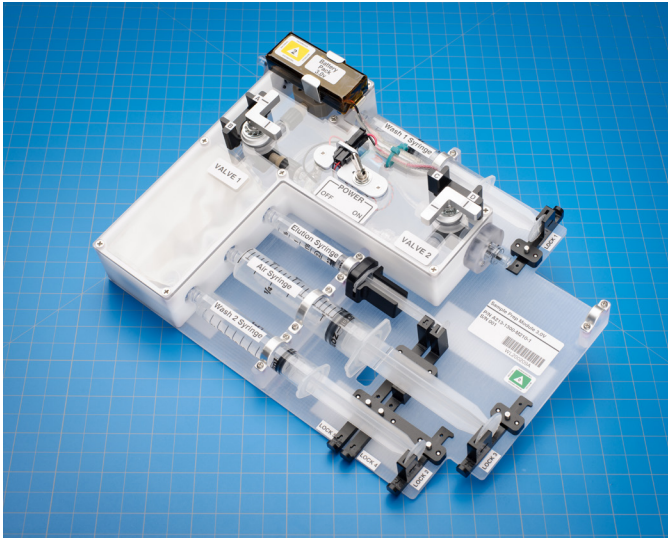


PCR reaction tube with a specialized cap that facilitates liquid handling operations and containment in micro-gravity. Image credit: NASA / Dominic Hart

from samples processed and analyzed aboard the space station.

Studies that characterize how spaceflight affects the gene expression of cells, microbes and tissues are key to helping researchers to better understand how life is affected by or adapts to spaceflight. Gene expression data helps reveal the molecular and cellular mechanisms involved with spaceflight-induced conditions such as bone and muscle loss, impaired immunity, and increased microbial virulence. Knowledge of these mechanisms can be applied towards developing countermeasures for protecting human health during long-term space missions and also for treating diseases on Earth.

Wetlab-2 will enable traditional uses of quantitative PCR, such as measuring gene transcription or rapid detection of gene targets that indicate infectious disease, cell stress, changes in cell cycle, growth and development, and/or genetic abnormality. Applications range from fundamental biology investigations to commercial drug discovery efforts. WetLab-2 also may be used for real-time analysis of air, surface, water, or clinical samples to monitor

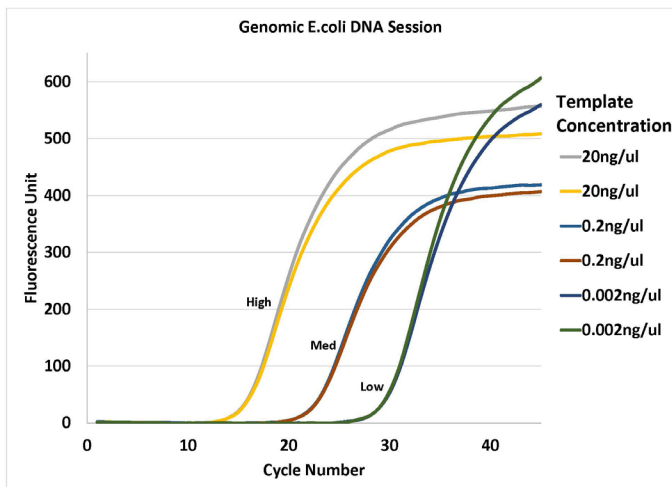


Sample Prep Module (SPM)

environmental conditions and crew health. It can also be used to validate terrestrial analyses of samples returned from the space station by providing quantitative gene expression benchmarking prior to sample return to Earth.

Components of the WetLab-2 system include a commercial quantitative PCR instrument (Cepheid SmartCycler), a sample transfer tool for retrieving samples from culturing hardware; and a set of fluidic modules to facilitate sample preparation work that will be done by astronaut crew working in a weightless environment.

Fluidic modules include: the sample processing module that is designed to lyse cells and extract RNA; the reaction assembly



Representative Data

National Aeronautics and Space Administration

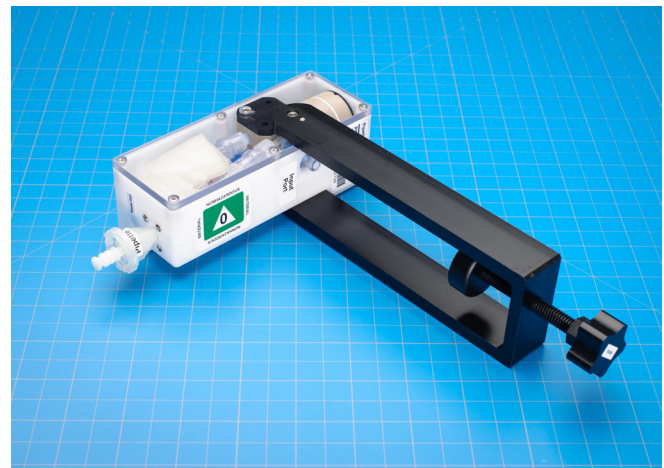
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module that removes air bubbles from fluids and transfers liquid samples into PCR reaction tubes; and PCR reaction tubes that are pre-loaded with stabilized lyophilized reagents and fitted with specialized caps for use in microgravity.

The SmartCycler can perform up to 16 quantitative PCR reactions in parallel, using up to four optical channels to measure fluorescence. The average time to deliver results is less than four hours.

Wetlab-2 is scheduled to fly to the station aboard SpaceX-7 in 2015. The goal of the first flight is to validate system performance. Wetlab-2 will be available for use by principal investigators after successful completion of this validation mission.



RNA Sample De-bubbler and Pipette Loading Device

WetLab-2 is being developed at NASA's Ames Research Center by the Engineering Directorate under the leadership of the Ames International Space Station Utilization Office. Science direction is provided by the Space Biosciences Division at Ames and the Space Life and Physical Sciences Division at NASA Headquarters. Project funding is provided by the International Space Station Program at NASA's Johnson Space Center, Houston.

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